



# Product Specification

AU Optronics Corporation

 Preliminary Specifications Final Specifications

Module	15.6"(15.55) FHD Color TFT-LCD with LED Backlight design
Model Name	B156HW01 V3 (H/W: 0A)
Note (  )	<b>LED Backlight with driving circuit design</b>

Customer	Date
Checked & Approved by	Date
<hr/> <hr/>	
Note: This Specification is subject to change without notice.	

Approved by	Date
Prepared by	
<u>Buffy Chen</u>	<u>01/16/2009</u>
<b>NBBU Marketing Division / AU Optronics corporation</b>	



# Product Specification

AU Optronics Corporation

## Contents

<b>1. Handling Precautions .....</b>	<b>4</b>
<b>2. General Description.....</b>	<b>5</b>
2.1 General Specification .....	5
2.2 Optical Characteristics .....	6
<b>3. Functional Block Diagram .....</b>	<b>11</b>
<b>4. Absolute Maximum Ratings .....</b>	<b>12</b>
4.1 Absolute Ratings of TFT LCD Module.....	12
4.2 Absolute Ratings of Environment .....	12
<b>5. Electrical characteristics.....</b>	<b>13</b>
5.1 TFT LCD Module .....	13
5.2 Backlight Unit.....	15
<b>6. Signal Characteristic .....</b>	<b>16</b>
6.1 Pixel Format Image .....	16
6.2 The input data format .....	17
6.3 Integration Interface and Pin Assignment.....	18
6.4 Interface Timing.....	22
<b>7. Connector Description .....</b>	<b>25</b>
7.1 TFT LCD Module .....	25
<b>8. LED Driving Specification .....</b>	<b>26</b>
8.1 Connector Description.....	26
8.2 Pin Assignment.....	26
<b>9. Vibration and Shock Test .....</b>	<b>27</b>
9.1 Vibration Test.....	27
9.2 Shock Test Spec:.....	27
<b>10. Reliability .....</b>	<b>28</b>
<b>11. Mechanical Characteristics .....</b>	<b>29</b>
11.1 LCM Outline Dimension .....	29
11.2 Screw Hole Depth and Center Position .....	31
<b>12. Shipping and Package .....</b>	<b>32</b>
12.1 Shipping Label Format .....	32
12.3 Carton package(TBD) .....	33
12.4 Shipping package of palletizing sequence .....	33
<b>13. Appendix: EDID description (TBD).....</b>	<b>34</b>



# Product Specification

AU Optronics Corporation

## Record of Revision

Version and Date	Page	Old description	New Description	Remark
0.1 2009/01/16	All	First Edition for Customer		



# Product Specification

AU OPTRONICS CORPORATION

## 1. Handling Precautions

- 1) Since front polarizer is easily damaged, pay attention not to scratch it.
- 2) Be sure to turn off power supply when inserting or disconnecting from input connector.
- 3) Wipe off water drop immediately. Long contact with water may cause discoloration or spots.
- 4) When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.
- 5) Since the panel is made of glass, it may break or crack if dropped or bumped on hard surface.
- 6) Since CMOS LSI is used in this module, take care of static electricity and insure human earth when handling.
- 7) Do not open nor modify the Module Assembly.
- 8) Do not press the reflector sheet at the back of the module to any directions.
- 9) At the insertion or removal of the Signal Interface Connector, be sure not to rotate nor tilt the Interface Connector of the TFT Module.
- 11) After installation of the TFT Module into an enclosure (Notebook PC Bezel, for example), do not twist nor bend the TFT Module even momentary. At designing the enclosure, it should be taken into consideration that no bending/twisting forces are applied to the TFT Module from outside. Otherwise the TFT Module may be damaged.
- 12) Small amount of materials having no flammability grade is used in the LCD module. The LCD module should be supplied by power complied with requirements of Limited Power Source (IEC60950 or UL1950), or be applied exemption.
- 13) Disconnecting power supply before handling LCD modules, it can prevent electric shock, DO NOT TOUCH the electrode parts, cables, connectors and LED circuit part of TFT module that a LED light bar build in as a light source of back light unit. It can prevent electrostatic breakdown.



# Product Specification

AU Optronics Corporation

## 2. General Description

B156HW01 V3 is a Color Active Matrix Liquid Crystal Display composed of a TFT LCD panel, a driver circuit, and LED backlight system. The screen format is intended to support the FHD (1920(H) x 1080(V)) screen and 262k colors (RGB 6-bits data driver) with LED backlight driving circuit. All input signals are LVDS interface compatible.

B156HW01 V3 is designed for a display unit of notebook style personal computer and industrial machine.

### 2.1 General Specification

The following items are characteristics summary on the table at 25 °C condition:

Items	Unit	Specifications			
Screen Diagonal	[mm]	394.87 ,15.6W" (15.55")			
Active Area	[mm]	344.16 X 193.59			
Pixels H x V		1920x3(RGB) x 1080			
Pixel Pitch	[mm]	0.215X0.215			
Pixel Format		R.G.B. Vertical Stripe			
Display Mode		Normally White			
White Luminance ( $I_{LED}=20mA$ ) <b>(Note: <math>I_{LED}</math> is LED current)</b>	[cd/m <sup>2</sup> ]	220 typ. (5 points average) 187 min. (5 points average)			
Luminance Uniformity		1.25 max. (5 points) 1.53 max. (13 points)			
Contrast Ratio		400:1			
Response Time	[ms]	8 typ/16max			
Nominal Input Voltage VDD	[Volt]	+3.3 typ.			
Power Consumption	[Watt]	8 max. (Include Logic and BLU power)			
Weight	[Grams]	470 max.			
Physical Size without inverter, bracket.	[mm]		Min.	Typ.	Max.
		Length	-	359.3	359.8
		Width	-	209.5	210
		Thickness	-	-	5.7
Electrical Interface		2 channel LVDS			
Glass Thickness	[mm]	0.5			
Surface Treatment		Anti-Glare			
Support Color		262K colors ( RGB 6-bit )			
Temperature Range Operating Storage (Non-Operating)	[°C] [°C]	0 to +50 -20 to +60			
RoHS Compliance		RoHS Compliance			



# Product Specification

AU Optronics Corporation

## 2.2 Optical Characteristics

The optical characteristics are measured under stable conditions at 25°C (Room Temperature) :

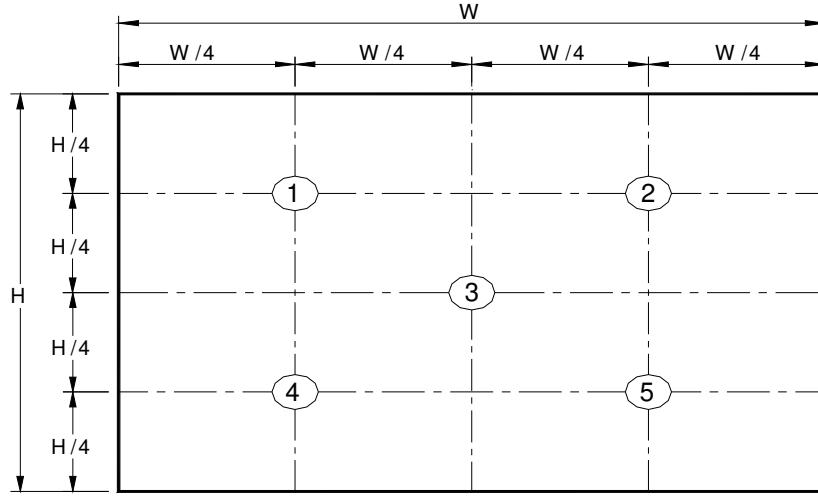
Item	Symbol	Conditions	Min.	Typ.	Max.	Unit	Note
<b>White Luminance</b> $I_{LED}=20mA$		<b>5 points average</b>	187	220	-	cd/ m <sup>2</sup>	1, 4, 5.
<b>Viewing Angle</b>	$\theta_R$	Horizontal (Right)	-	70	-	degree	
	$\theta_L$	CR = 10 (Left)	-	70	-	e	4, 9
	$\Psi_H$	Vertical (Upper)	-	60	-		
	$\Psi_L$	CR = 10 (Lower)	-	60	-		
<b>Luminance Uniformity</b>	$\delta_{5P}$	<b>5 Points</b>	-	-	1.25		1, 3, 4
<b>Luminance Uniformity</b>	$\delta_{13P}$	<b>13 Points</b>	-	-	1.53		2, 3, 4
<b>Contrast Ratio</b>	CR		300	400	-		4, 6
<b>Cross talk</b>	%				TBD		4, 7
<b>Response Time</b>	$T_r$	Rising	-	TBD	-		
	$T_f$	Falling	-	TBD	-	msec	4, 8
	$T_{RT}$	Rising + Falling	-	8	16		
<b>Color / Chromaticity Coordinates</b>	<b>Red</b>	$R_x$	-	TBD	-		
	<b>Red</b>	$R_y$	-	TBD	-		
	<b>Green</b>	$G_x$	-	TBD	-		
	<b>Green</b>	$G_y$	-	TBD	-		
<b>Blue</b>	<b>Blue</b>	$B_x$	CIE 1931	-	TBD	-	4
	<b>Blue</b>	$B_y$		-	TBD	-	
	<b>White</b>	$W_x$		0.283	0.313	0.343	
	<b>White</b>	$W_y$		0.299	0.329	0.359	
<b>NTSC</b>	%		-	60	-		



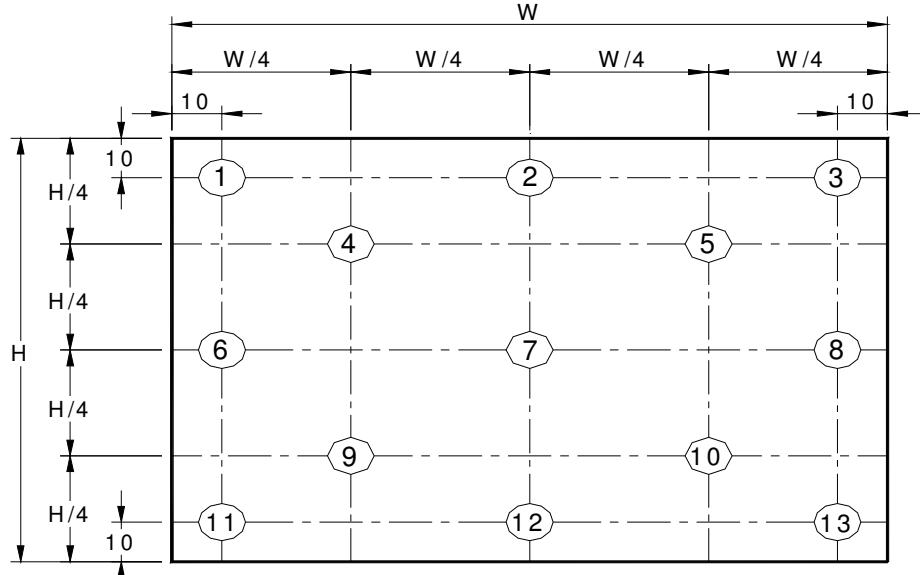
# Product Specification

AU Optronics Corporation

**Note 1:** 5 points position (Ref: Active area)



**Note 2:** 13 points position (Ref: Active area)



**Note 3:** The luminance uniformity of 5 or 13 points is defined by dividing the maximum luminance values by the minimum test point luminance

$$\delta_{W5} = \frac{\text{Maximum Brightness of five points}}{\text{Minimum Brightness of five points}}$$

$$\delta_{W13} = \frac{\text{Maximum Brightness of thirteen points}}{\text{Minimum Brightness of thirteen points}}$$

**Note 4:** Measurement method

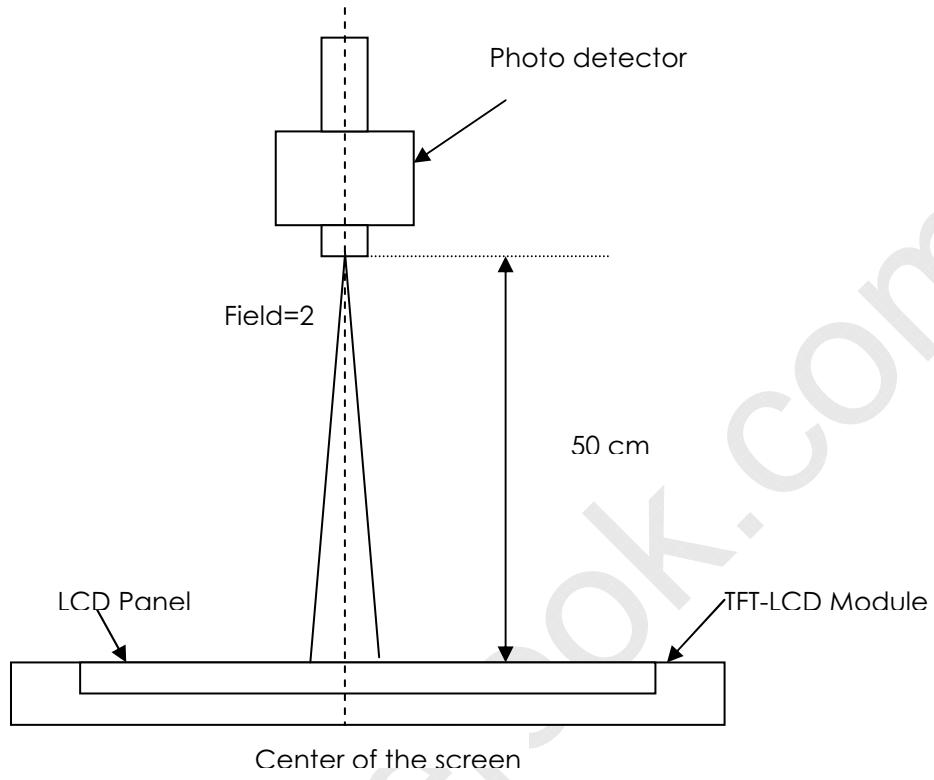
The LCD module should be stabilized at given temperature for 30 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after



# Product Specification

AU Optronics Corporation

lighting Backlight for 30 minutes in a stable, windless and dark room, and it should be measured in the center of screen.



**Note 5 :** Definition of Average Luminance of White ( $Y_L$ ):

Measure the luminance of gray level 63 at 5 points ,  $Y_L = [L(1)+L(2)+L(3)+L(4)+L(5)] / 5$

$L(x)$  is corresponding to the luminance of the point  $X$  at Figure in Note (1).

**Note 6 :** Definition of contrast ratio:

Contrast ratio is calculated with the following formula.

$$\text{Contrast ratio (CR)} = \frac{\text{Brightness on the "White" state}}{\text{Brightness on the "Black" state}}$$

**Note 7 :** Definition of Cross Talk (CT)

$$CT = |Y_B - Y_A| / Y_A \times 100 \%$$

Where

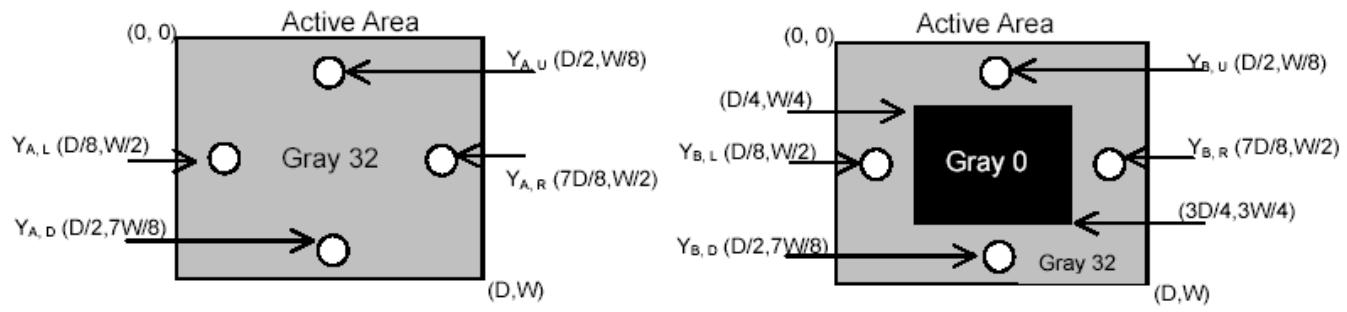
$Y_A$  = Luminance of measured location without gray level 0 pattern ( $cd/m^2$ )

$Y_B$  = Luminance of measured location with gray level 0 pattern ( $cd/m^2$ )



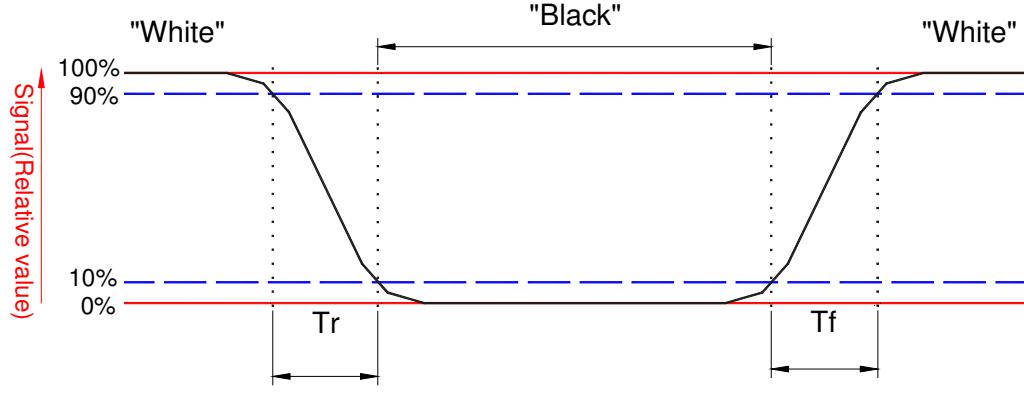
# Product Specification

AU Optronics Corporation



**Note 8:** Definition of response time:

The output signals of BM-7 or equivalent are measured when the input signals are changed from "Black" to "White" (falling time) and from "White" to "Black" (rising time), respectively. The response time interval between the 10% and 90% of amplitudes. Refer to figure as below.



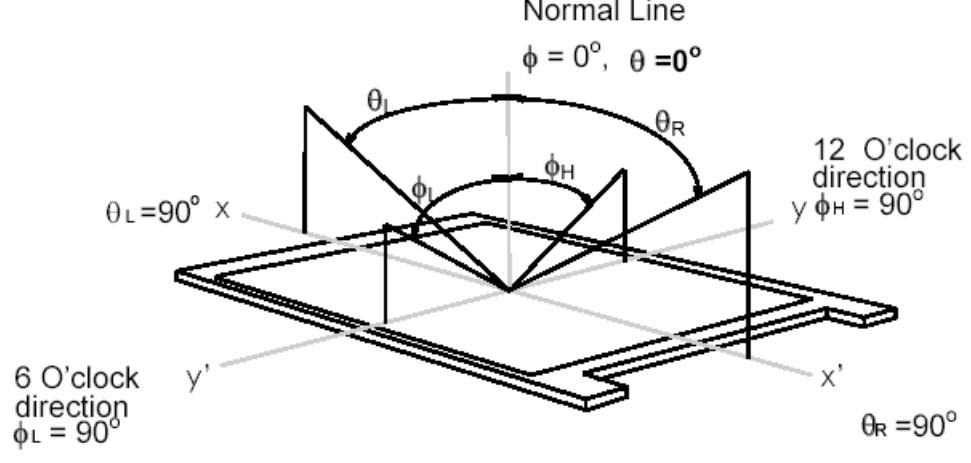


# Product Specification

AU OPTRONICS CORPORATION

**Note 9.** Definition of viewing angle

Viewing angle is the measurement of contrast ratio  $\geq 10$ , at the screen center, over a  $180^\circ$  horizontal and  $180^\circ$  vertical range (off-normal viewing angles). The  $180^\circ$  viewing angle range is broken down as follows;  $90^\circ$  ( $\theta$ ) horizontal left and right and  $90^\circ$  ( $\Phi$ ) vertical, high (up) and low (down). The measurement direction is typically perpendicular to the display surface with the screen rotated about its center to develop the desired measurement viewing angle.



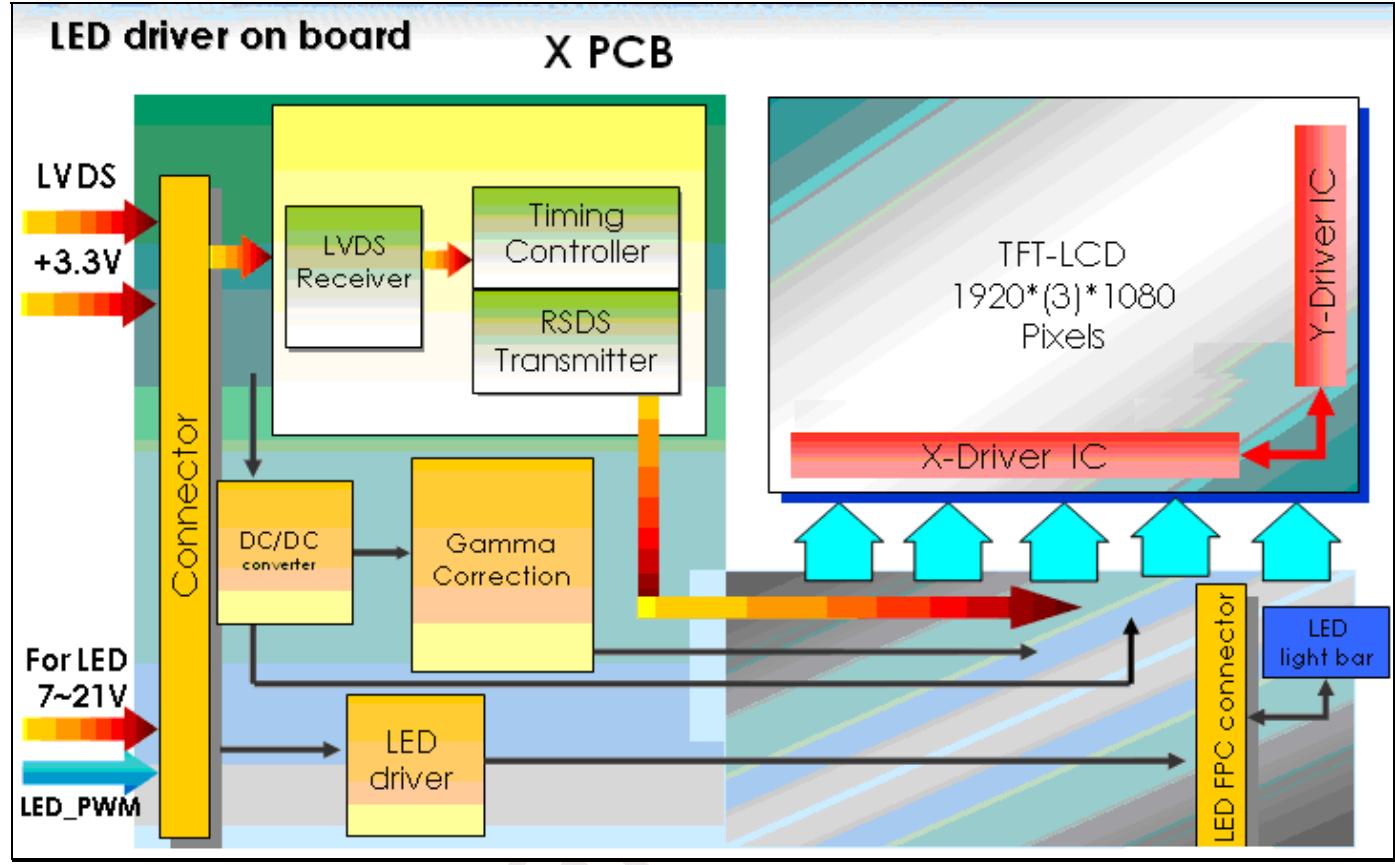


# Product Specification

AU Optronics Corporation

## 3. Functional Block Diagram

The following diagram shows the functional block of the 15.6 inches wide Color TFT/LCD 40 Pin. (Two CH/connector Module)





# Product Specification

AU Optronics Corporation

## 4. Absolute Maximum Ratings

An absolute maximum rating of the module is as following:

### 4.1 Absolute Ratings of TFT LCD Module

Item	Symbol	Min	Max	Unit	Conditions
Logic/LCD Drive	V <sub>in</sub>	-0.3	+4.0	[Volt]	Note 1,2

### 4.2 Absolute Ratings of Environment

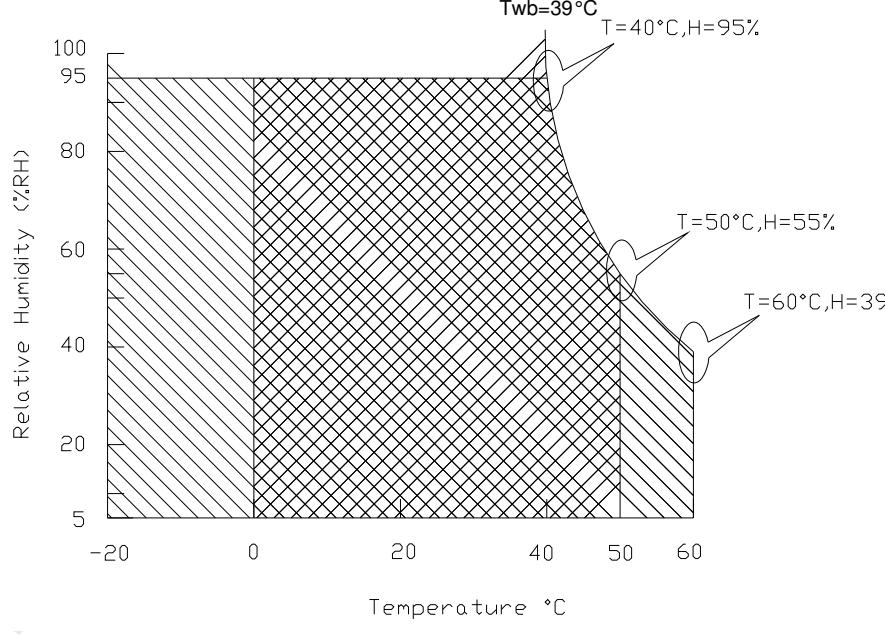
Item	Symbol	Min	Max	Unit	Conditions
Operating	TOP	0	+50	[°C]	Note 4
Operation Humidity	HOP	5	95	[%RH]	Note 4
Storage Temperature	TST	-20	+60	[°C]	Note 4
Storage Humidity	HST	5	95	[%RH]	Note 4

Note 1: At Ta (25°C)

Note 2: Permanent damage to the device may occur if exceed maximum values

Note 3: LED specification refer to section 5.2

Note 4: For quality performance, please refer to AUO IIS (Incoming Inspection Standard).



Operating Range

Storage Range

+



# Product Specification

AU Optronics Corporation

## 5. Electrical characteristics

### 5.1 TFT LCD Module

#### 5.1.1 Power Specification

Input power specifications are as follows:

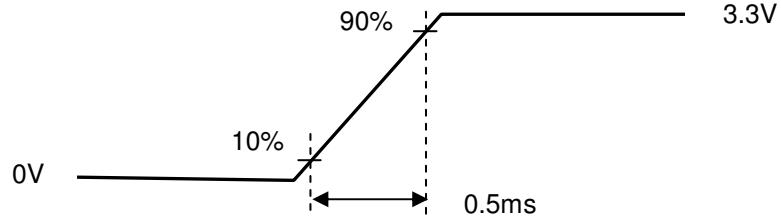
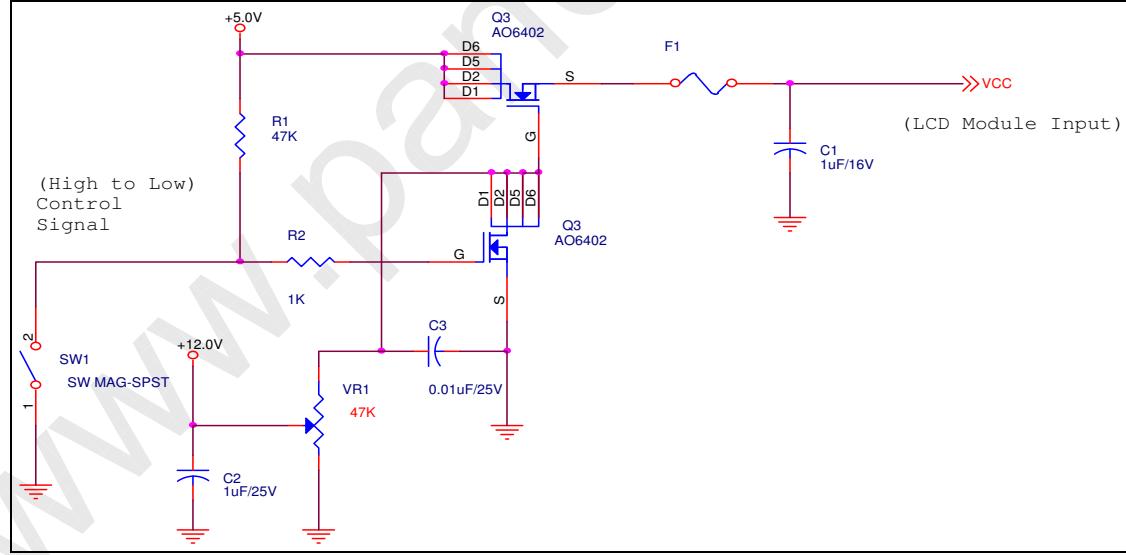
The power specification are measured under 25°C and frame frequency under 60Hz

Symbol	Parameter	Min	Typ	Max	Units	Note
VDD	Logic/LCD Drive Voltage	3.0	3.3	3.6	[Volt]	
PDD	VDD Power	-	-	TBD	[Watt]	Note 1/2
IDD	IDD Current	-	-	TBD	[mA]	Note 1/2
IRush	Inrush Current	-	-	TBD	[mA]	Note 3
VDDRp	Allowable Logic/LCD Drive Ripple Voltage	-	-	TBD	[mV] p-p	

Note 1 : Maximum Measurement Condition : Black Pattern

Note 2 : Typical Measurement Condition: Mosaic Pattern

Note 3 : Measure Condition





# Product Specification

AU Optronics Corporation

## 5.1.2 Signal Electrical Characteristics

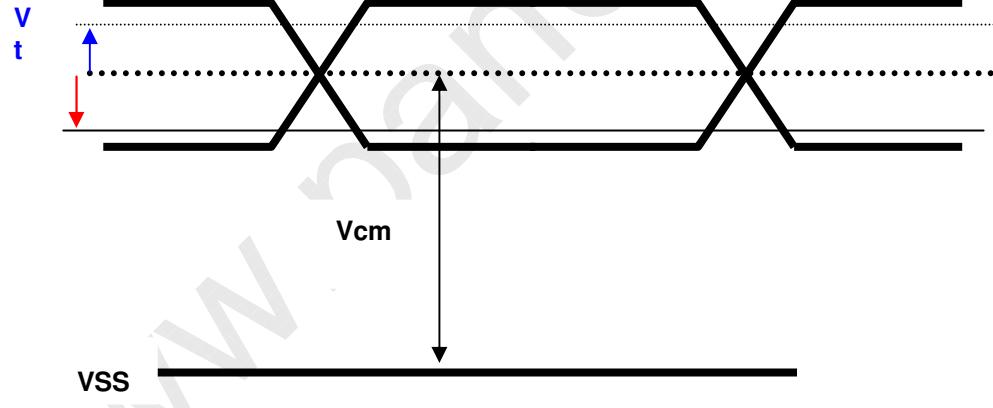
Input signals shall be low or High-impedance state when VDD is off.

It is recommended to refer the specifications of THC63LVDF84A (Thine Electronics Inc.) in detail.

Signal electrical characteristics are as follows;

Parameter	Condition	Min	Max	Unit
V <sub>th</sub>	Differential Input High Threshold (V <sub>cm</sub> =+1.2V)	-	100	[mV]
V <sub>tl</sub>	Differential Input Low Threshold (V <sub>cm</sub> =+1.2V)	-100	-	[mV]
V <sub>cm</sub>	Differential Input Common Mode Voltage	1.125	1.375	[V]

Note: LVDS Signal Waveform





# Product Specification

AU OPTRONICS CORPORATION

## 5.2 Backlight Unit

LED Parameter guideline for LED driving selection (Ref. Remark 1)

Parameter	Symbol	Min	Typ	Max	Units	Condition
LED Forward Voltage	$V_F$	3.0	3.2	3.4	[Volt]	( $T_a=25^\circ C$ )
LED Forward Current	$I_F$		20		[mA]	( $T_a=25^\circ C$ )
LED Power consumption	$P_{LED}$		5.49		[Watt]	( $T_a=25^\circ C$ ) Note 1
LED Life-Time	N/A	10,000	-	-	Hour	( $T_a=25^\circ C$ ) $I_F=20$ mA Note 2
Output PWM frequency	$F_{PWM}$	100	200	20K	Hz	
Duty ratio	--	5	--	100	%	

**Note 1:** Calculator value for reference  $P_{LED} = V_F \text{ (Normal Distribution)} * I_F \text{ (Normal Distribution)} / \text{Efficiency}$

**Note 2:** The LED life-time define as the estimated time to 50% degradation of initial luminous.



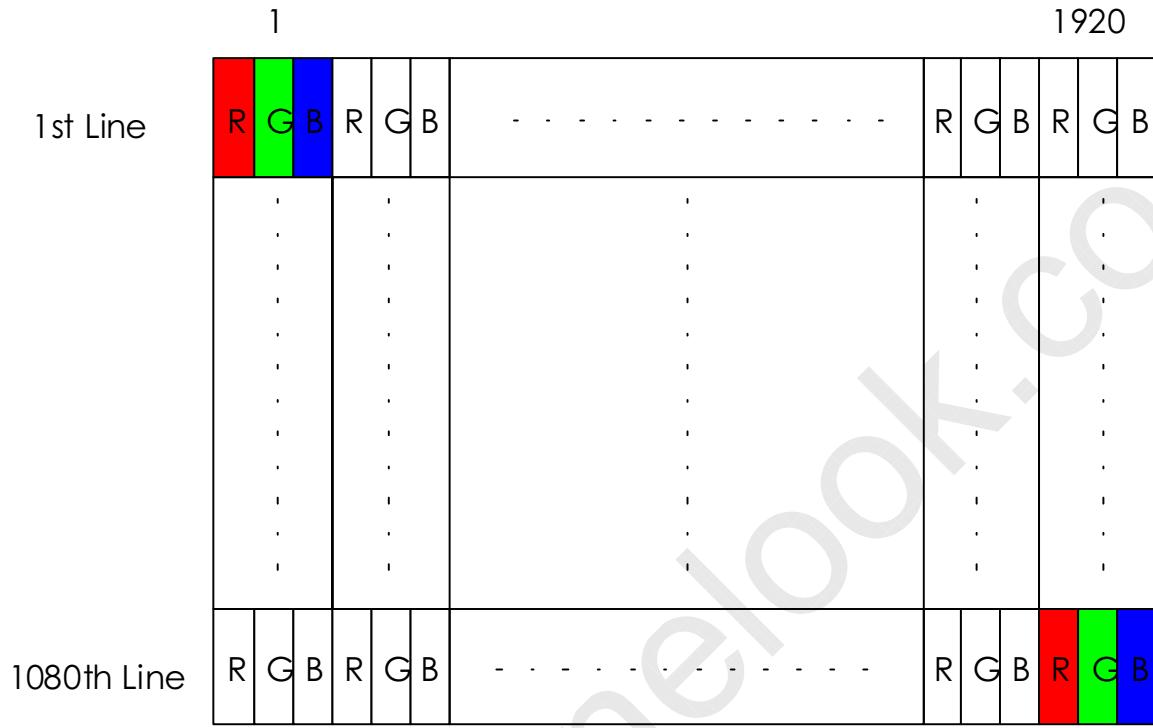
# Product Specification

AU OPTRONICS CORPORATION

## 6. Signal Characteristic

### 6.1 Pixel Format Image

Following figure shows the relationship of the input signals and LCD pixel format.

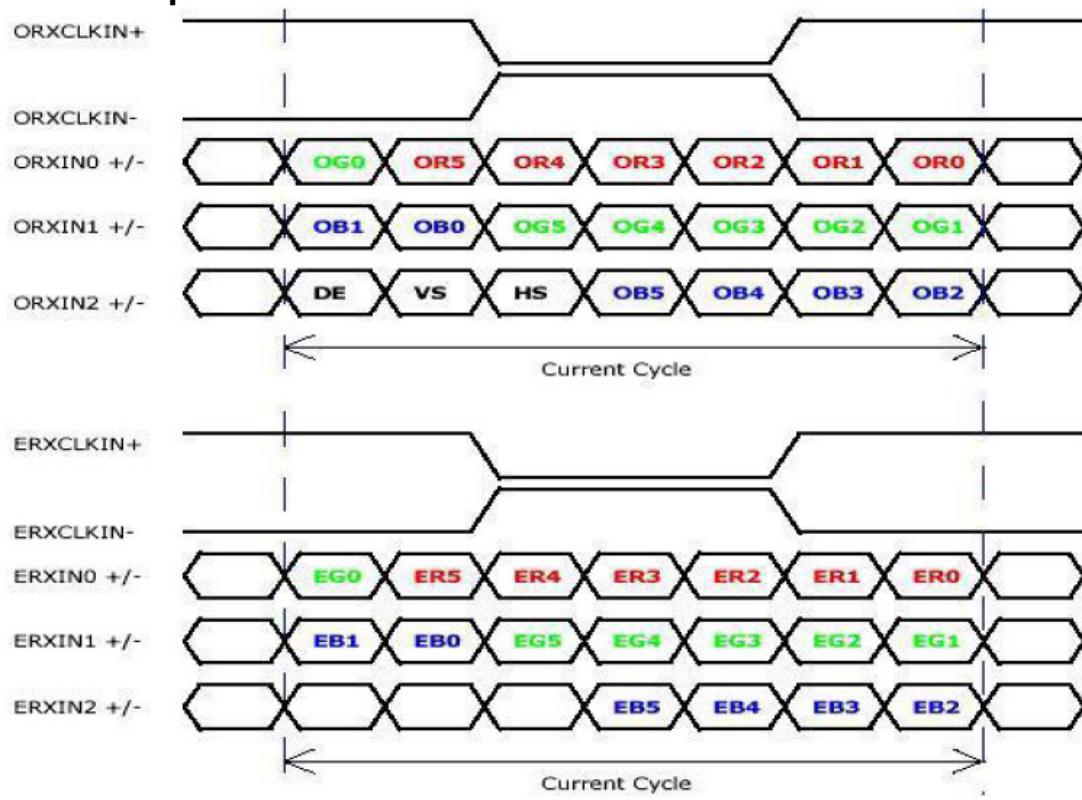




# Product Specification

AU Optronics Corporation

## 6.2 The input data format



Signal Name	Description	
R5 R4 R3 R2 R1 R0	Red Data 5 (MSB) Red Data 4 Red Data 3 Red Data 2 Red Data 1 Red Data 0 (LSB)	Red-pixel Data Each red pixel's brightness data consists of these 6 bits pixel data.
G5 G4 G3 G2 G1 G0	Green Data 5 (MSB) Green Data 4 Green Data 3 Green Data 2 Green Data 1 Green Data 0 (LSB)	Green-pixel Data Each green pixel's brightness data consists of these 6 bits pixel data.
B5 B4 B3 B2 B1 B0	Blue Data 5 (MSB) Blue Data 4 Blue Data 3 Blue Data 2 Blue Data 1 Blue Data 0 (LSB)	Blue-pixel Data Each blue pixel's brightness data consists of these 6 bits pixel data.
RxCLKIN	Data Clock	The signal is used to strobe the pixel data and DE signals. All pixel data shall be valid at the falling edge when the DE signal is high
DE	Display Timing	This signal is strobed at the falling edge of RxCLKIN. When the signal is high, the pixel data shall be valid to be displayed.
VS	Vertical Sync	The signal is synchronized to RxCLKIN .
HS	Horizontal Sync	The signal is synchronized to RxCLKIN .

Note: Output signals from any system shall be low or High-impedance state when VDD is off.



# Product Specification

AU Optronics Corporation

## 6.3 Integration Interface and Pin Assignment

LVDS is a differential signal technology for LCD interface and high speed data transfer device.

Pin	Signal	Description
1	NC	No Connection (Reserve)
2	AVDD	PowerSupply,3.3V(typical)
3	AVDD	PowerSupply,3.3V(typical)
4	DVDD	DDC 3.3Vpower
5	NC	No Connection (Reserve)
6	SCL	DDCClock
7	SDA	DDCData
8	Odd_Rin0-	-LVDSdifferential data input(R0-R5,G0)
9	Odd_Rin0+	+LVDSdifferential data input(R0-R5,G0)
10	GND	Ground
11	Odd_Rin1-	-LVDSdifferential data input(G1-G5,B0-B1)
12	Odd_Rin1+	+LVDSdifferential data input(G1-G5,B0-B1)
13	GND	Ground
14	Odd_Rin2-	-LVDSdifferential data input(B2-B5,HS,VS,DE)
15	Odd_Rin2+	+LVDSdifferential data input(B2-B5,HS,VS,DE)
16	GND	Ground
17	Odd_ClkIN-	-LVDSdifferential clock input
18	Odd_ClkIN+	+LVDSdifferential clock input
19	GND	Ground-Shield
20	Even_Rin0-	-LVDSdifferential data input(R0-R5,G0)
21	Even_Rin0+	+LVDSdifferential data input(R0-R5,G0)
22	GND	Ground
23	Even_Rin1-	-LVDSdifferential data input(G1-G5,B0-B1)
24	Even_Rin1+	+LVDSdifferential data input(G1-G5,B0-B1)
25	GND	Ground
26	Even_Rin2-	-LVDSdifferential data input(B2-B5,HS,VS,DE)
27	Even_Rin2+	+LVDSdifferential data input(B2-B5,HS,VS,DE)
28	GND	Ground
29	Even_ClkIN-	-LVDSdifferential clock input
30	Even_ClkIN+	+LVDSdifferential clock input
31	GND	Ground-Shield
32	VLED_GND	LED Ground
33	VLED_GND	LED Ground
34	NC	No Connection (Reserve)
35	PWM	System PWM Signal Input
36	LED_EN	LED enable pin(+3.3V Input)



# Product Specification

AU Optronics Corporation

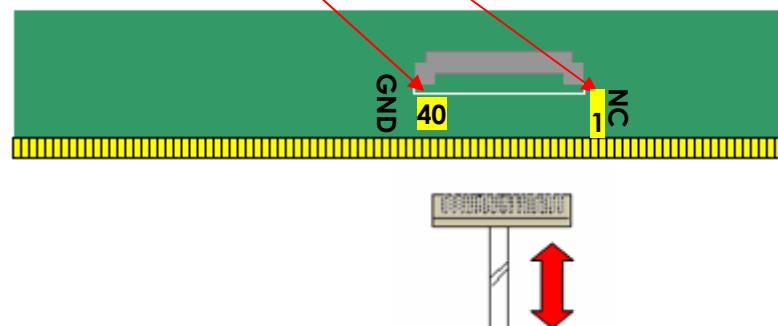
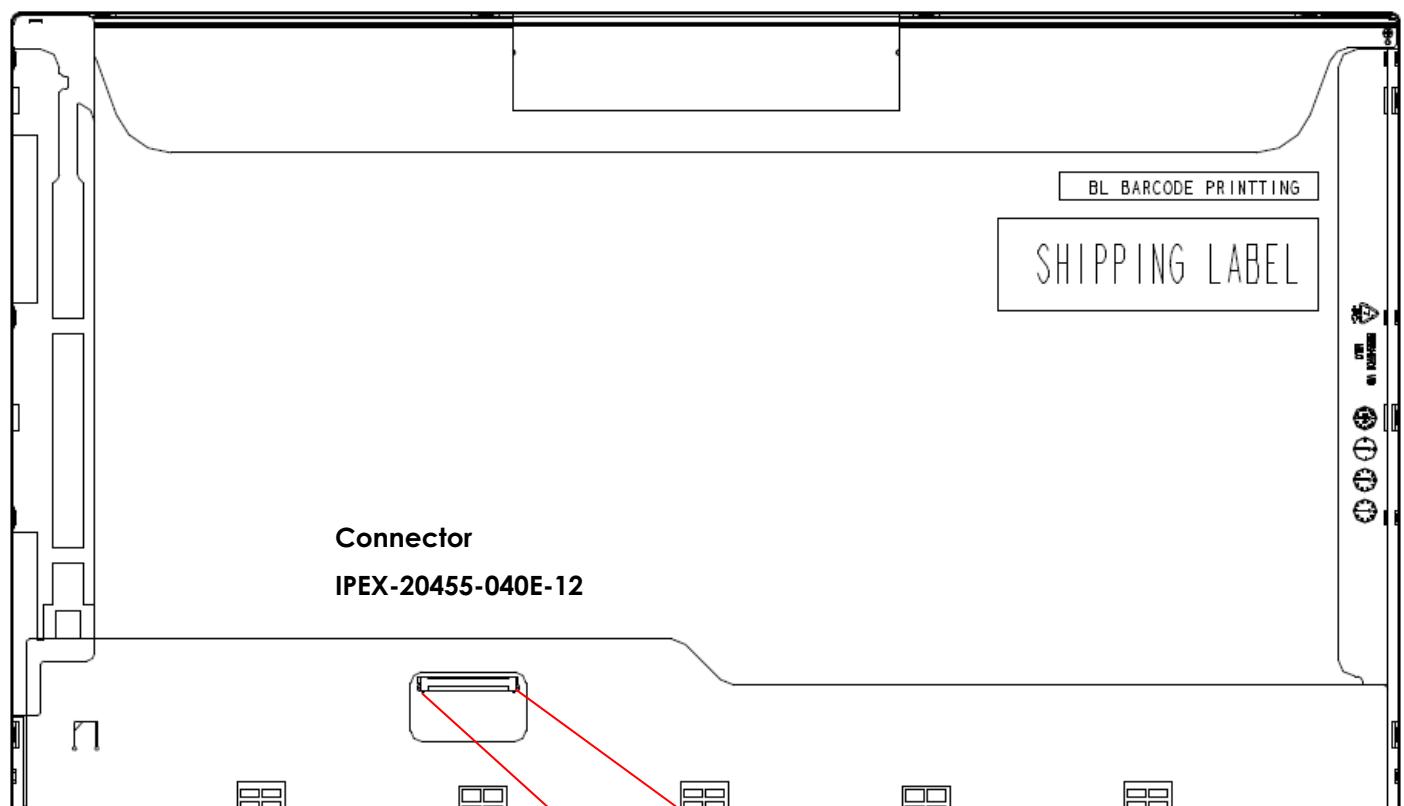
37	NC	No Connection (Reserve)
38	VLED	LED Power Supply 7V-20V
39	VLED	LED Power Supply 7V-20V
40	VLED	LED Power Supply 7V-20V



# Product Specification

AU OPTRONICS CORPORATION

Note1: Start from right side



Note2: Input signals shall be low or High-impedance state when VDD is off.

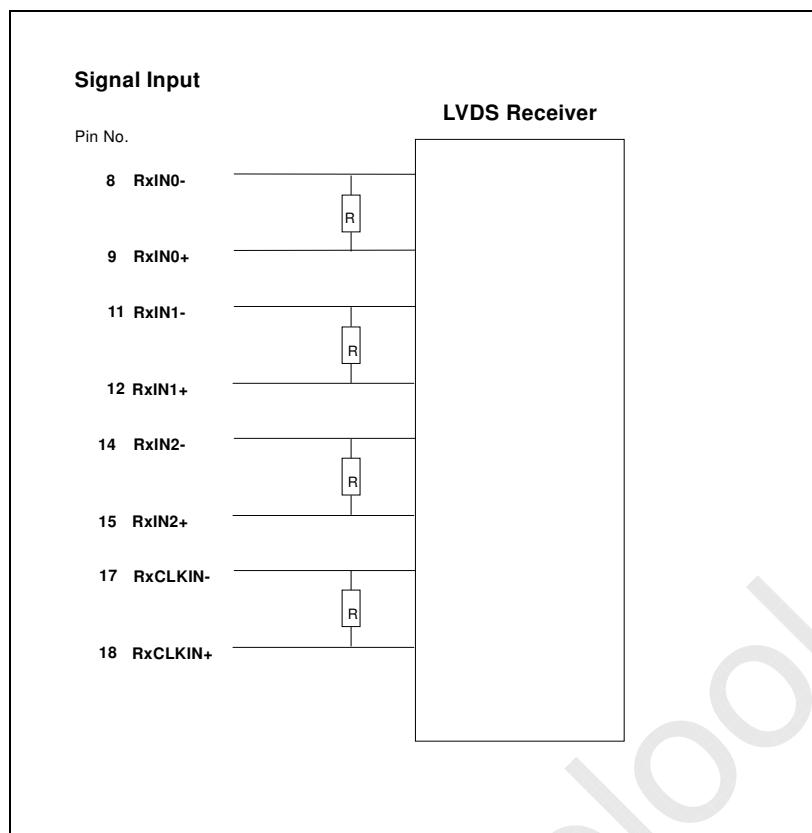


# Product Specification

AU OPTRONICS CORPORATION

internal circuit of LVDS inputs are as following.

The module uses a 100ohm resistor between positive and negative data lines of each receiver input





# Product Specification

AU Optronics Corporation

## 6.4 Interface Timing

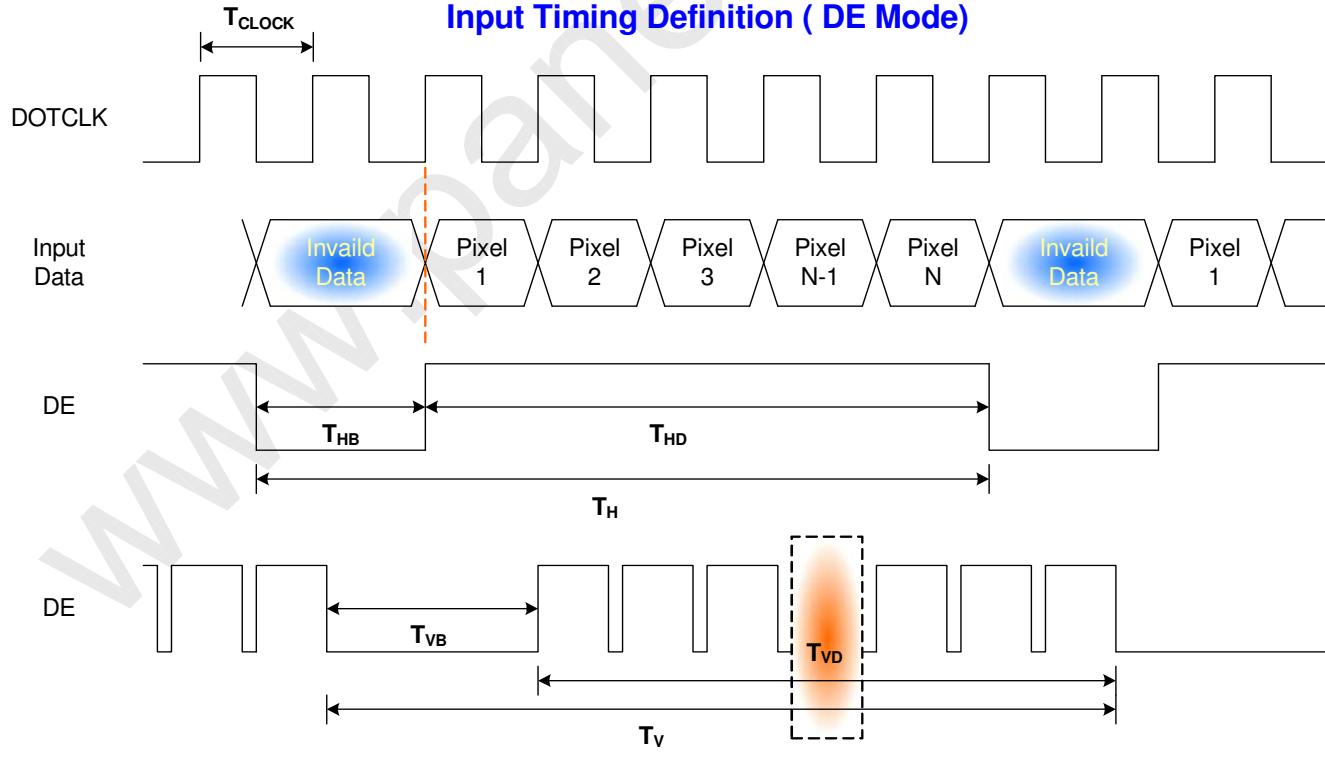
### 6.4.1 Timing Characteristics

Basically, interface timings should match the 1920x1080 /60Hz manufacturing guide line timing.

Parameter	Symbol	Min.	Typ.	Max.	Unit	
Frame Rate	-	50	60	-	Hz	
Clock frequency	$1 / T_{Clock}$	64.63	71.19	TBD	MHz	
Vertical Section	Period	$T_V$	1088	1130	$T_{Line}$	
	Active	$T_{VD}$	1080			
	Blanking	$T_{VB}$	8	50		
Horizontal Section	Period	$T_H$	990	1050	$T_{Clock}$	
	Active	$T_{HD}$	960			
	Blanking	$T_{HB}$	30	90		

Note : DE mode only

### 6.4.2 Timing diagram



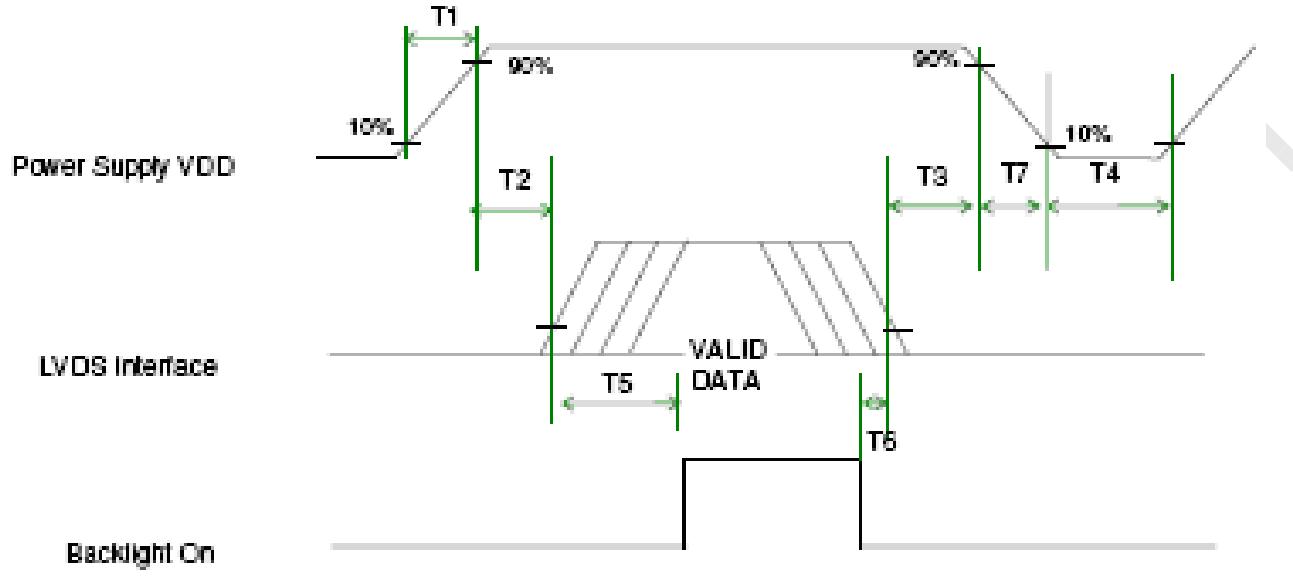


# Product Specification

AU OPTRONICS CORPORATION

## 6.5 Power ON/OFF Sequence

VDD power on/off sequence is as follows. Interface signals are also shown in the chart. Signals from any system shall be Hi-Z state or low level when VDD is off



Power Sequence Timing

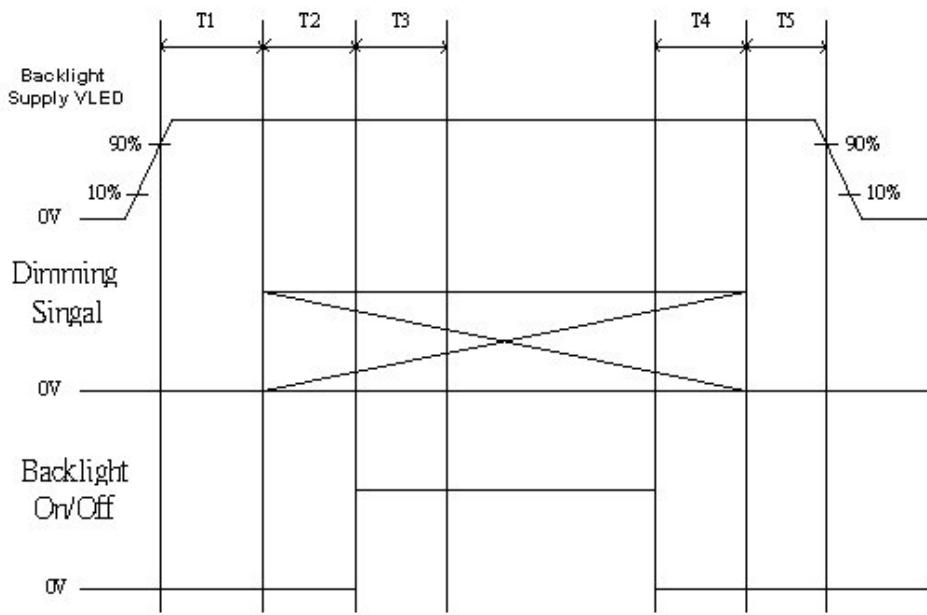
Parameter	Value			Units
	Min.	Typ.	Max.	
T1	0.5	-	10	
T2	0	-	50	
T3	0	-	50	
T4	400	-	-	ms
T5	200	-	-	
T6	200	-	-	
T7	0	-	10	



# Product Specification

AU Optronics Corporation

LED on/off sequence is as follows. Interface signals are also shown in the chart.



Symbol	Values			Unit
	Min	Typ	Max	
<b>T1</b>	10	---	---	ms
<b>T2</b>	10	---	---	
<b>T3</b>	50	---	---	
<b>T4</b>	0	---	---	
<b>T5</b>	10	---	---	



## Product Specification

AU Optronics Corporation

### 7. Connector Description

Physical interface is described as for the connector on module.

These connectors are capable of accommodating the following signals and will be following components.

#### 7.1 TFT LCD Module

Connector Name / Designation	For Signal Connector
Manufacturer	IPEX or compatible
Type / Part Number	IPEX-20455-040E-12 or compatible
Mating Housing/Part Number	IPEX-20453-040T-11 or compatible



# Product Specification

AU Optronics Corporation

## 8. LED Driving Specification

### 8.1 Connector Description

It is a intergrative interface and comibe into LVDS connector. The type and mating refer to section 7.

### 8.2 Pin Assignment

Ref. to 6.3



# Product Specification

AU OPTRONICS CORPORATION

## 9. Vibration and Shock Test

### 9.1 Vibration Test

**Test Spec:**

- Test method: Non-Operation
- Acceleration: 1.5 G
- Frequency: 10 - 500Hz Random
- Sweep: 30 Minutes each Axis (X, Y, Z)

### 9.2 Shock Test Spec:

**Test Spec:**

- Test method: Non-Operation
- Acceleration: 220 G , Half sine wave
- Active time: 2 ms
- Pulse: X,Y,Z .one time for each side



# Product Specification

AU OPTRONICS CORPORATION

## 10. Reliability

Items	Required Condition	Note
Temperature Humidity Bias	Ta= 40°C, 90%RH, 300h	
High Temperature Operation	Ta= 50°C, Dry, 300h	
Low Temperature Operation	Ta= 0°C, 300h	
High Temperature Storage	Ta= 60°C, 35%RH, 300h	
Low Temperature Storage	Ta= -20°C, 50%RH, 300h	
Thermal Shock Test	Ta=-20°C to 60°C, Duration at 30 min, 100 cycles	
ESD	Contact : $\pm 8$ KV Air : $\pm 15$ KV	Note 1

**Note1:** According to EN 61000-4-2 , ESD class B: Some performance degradation allowed. No data lost

- . Self-recoverable. No hardware failures.

**Remark:** MTBF (Excluding the LED): 30,000 hours with a confidence level 90%

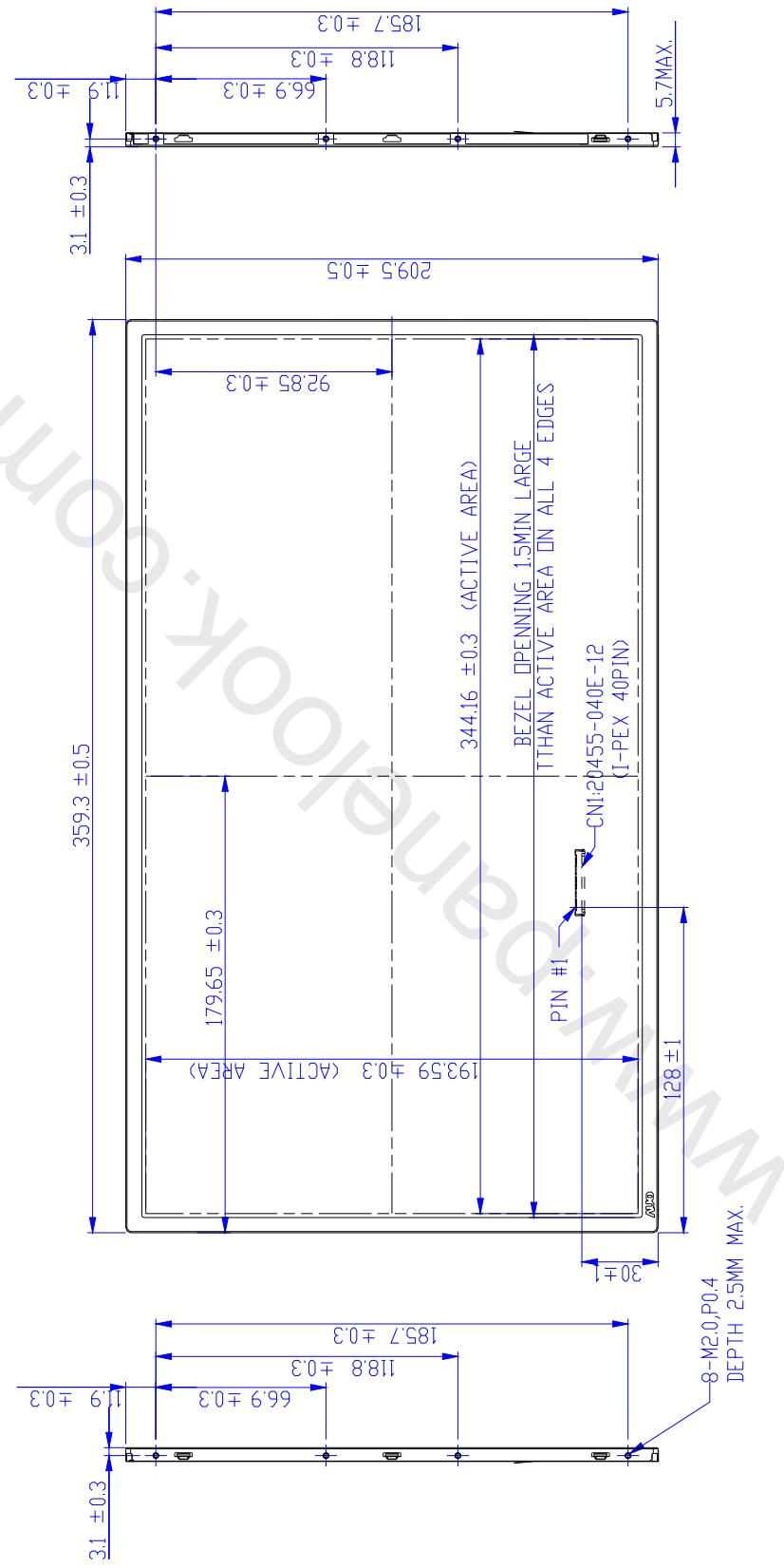


# Product Specification

AUOPTRONICS CORPORATION

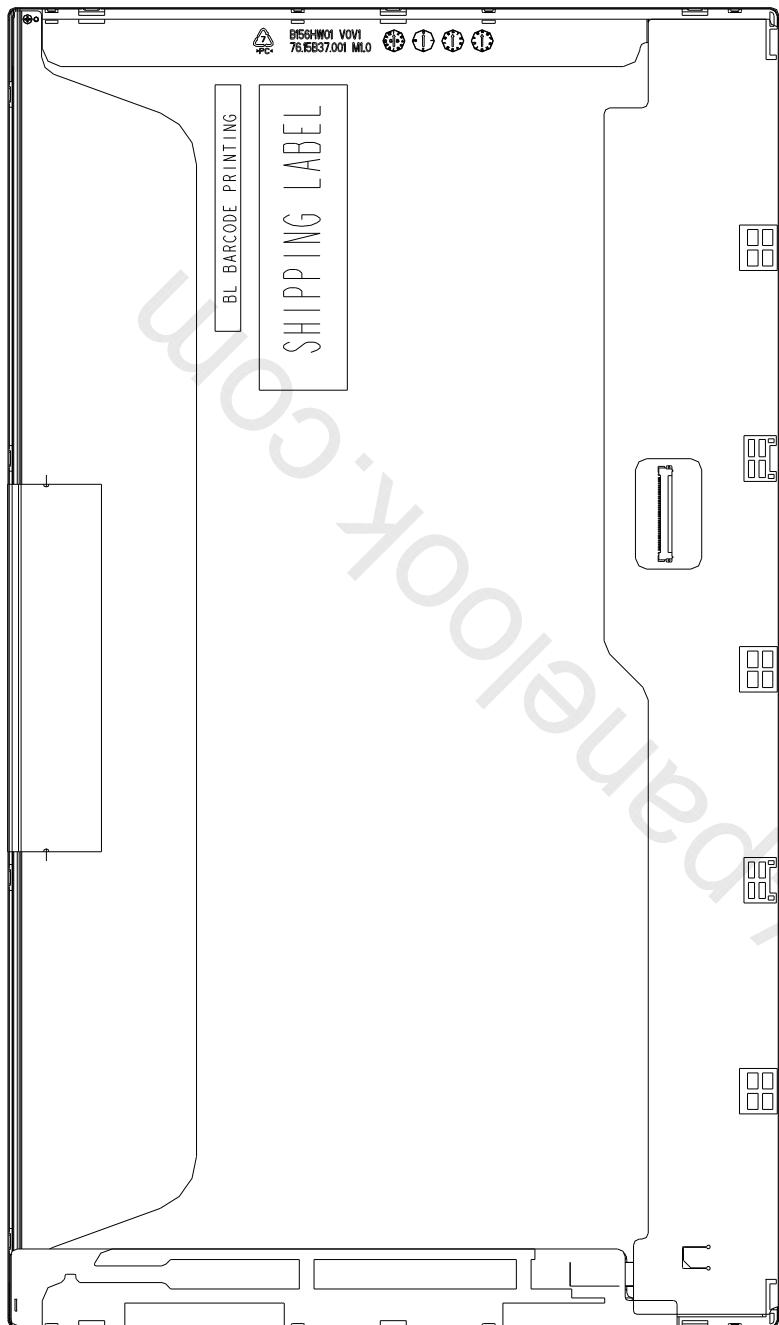
## 11. Mechanical Characteristics

### 11.1 LCM Outline Dimension



# Product Specification

AU Optronics Corporation



Note: Prevention IC damage, IC positions not allowed any overlap over these areas.



## Product Specification

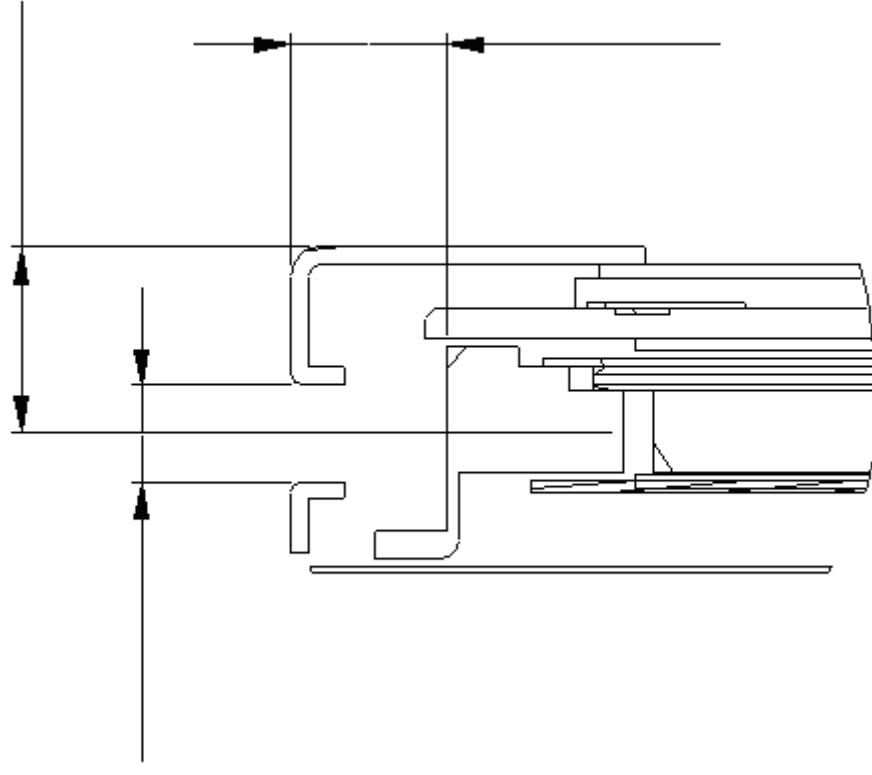
AU Optronics Corporation

### 11.2 Screw Hole Depth and Center Position

Screw hole minimum depth, from side surface = TBD  $\pm$  0.3 mm (See drawing)

Screw hole center location, from front surface = TBD  $\pm$  0.3mm (See drawing)

Screw Torque: Maximum 2.5 kgf-cm





# Product Specification

AU Optronics Corporation

## 12. Shipping and Package

### 12.1 Shipping Label Format



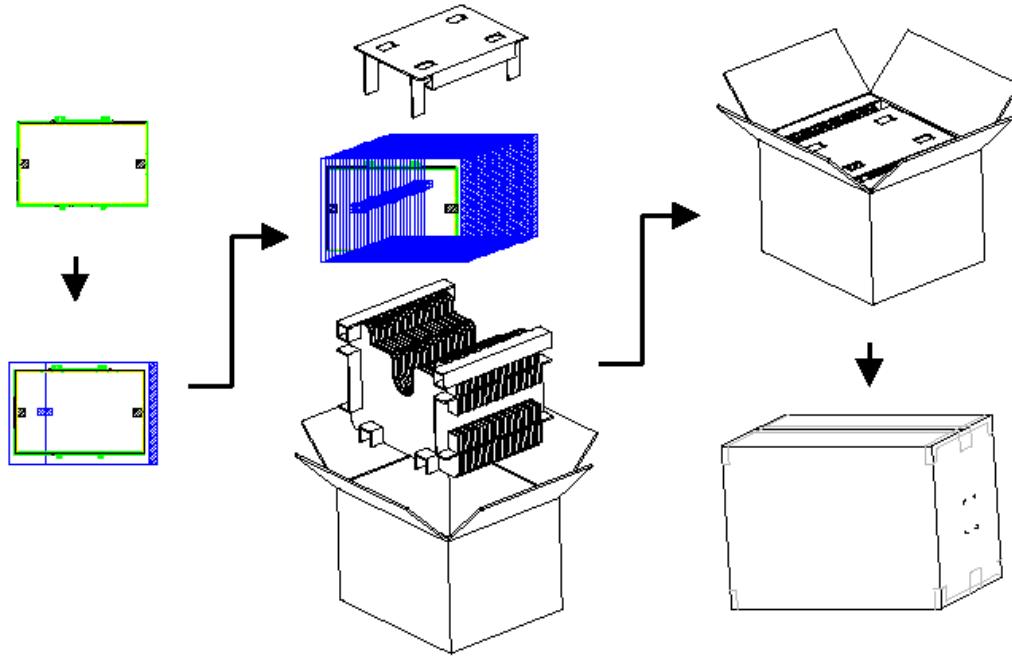


## Product Specification

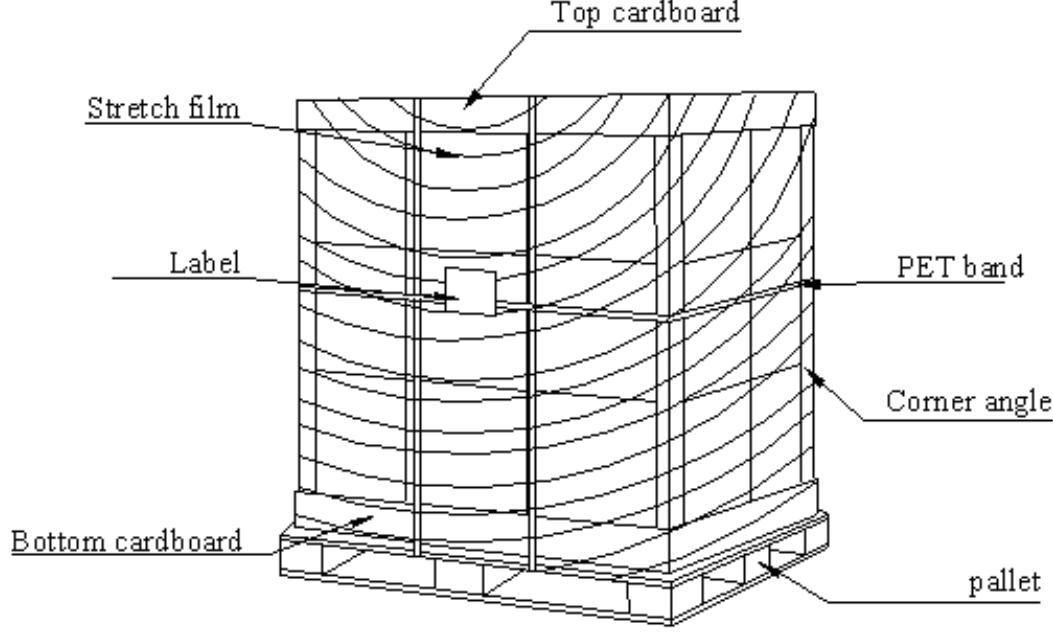
AU Optronics Corporation

### 12.3 Carton package

The outside dimension of carton is 455 (L)mm x 380 (W)mm x 355 (H)mm



### 12.4 Shipping package of palletizing sequence





## Product Specification

AU Optronics Corporation

### 13. Appendix: EDID description (TBD)